

**INVESTIGATION OF
HAWTHORNE ARMY AMMUNITION PLANT
MAGAZINE FIRE - 9 AUGUST 1989**

ROBERT A. LOYD

**U.S. ARMY ARMAMENT
MUNITIONS AND CHEMICAL COMMAND**

**24th DEPARTMENT OF DEFENSE
EXPLOSIVES SAFETY SEMINAR
27-30 AUGUST 1990**

Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE AUG 1990		2. REPORT TYPE		3. DATES COVERED 00-00-1990 to 00-00-1990	
4. TITLE AND SUBTITLE Magazine Fire - Hawthorne Army Ammunition Plant - 9 August 1989				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army Armament Munitions and Chemical Command, ,Rock Island,IL,61299				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES See also ADA235006, Volume 2. Minutes of the Explosives Safety Seminar (24th) Held in St. Louis, MO on 28-30 August 1990.					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 52	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

Investigation of the Hawthorne Army Ammunition Plant (AAP) Magazine Fire
9 August 1989

1. Executive Summary: A magazine fire involving 30,715 pounds of Navy propelling charges (hazard class 1.3/mass fire) occurred at Hawthorne AAP. The material was stored in Magazine 116-14-E. The propellant was unservicable (condition code H), awaiting disposal instructions. At 0930, 9 August 1989, a nearby work crew heard a "bang" followed by smoke and sparks coming from the magazine door vents and smoke from the rear ventilator. The doors were then forced open by the pressure of the burning propellant followed by a large jet of flame. The magazine was allowed to cool overnight. An explosive ordnance disposal (EOD) team entered the magazine the next morning and determined there was no unburned propellant in the magazine. The most probable cause was spontaneous ignition due to low stabilizer of 8-inch, 55-caliber bagged propelling charges (national stock number (NSN) 1320-00-089-4275; Department of Defense identification code (DODIC) D605 located in the left front portion of the magazine. This was based on: the known low stabilizer content (0.04 to .13 percent) of seven 8-inch propelling charges lots located in this area (lot numbers DG-2-CO-68, DGR-1-HAW-55, DGR-11-CO-68, DGR-13-CO-68, DGR-14-CO-68, DGR-5-CO-69, and DGR-8-C-51); heavy fire damage occurring in the left front portion of the magazine; and analysis of observations made by several witnesses.

2. Description of facility: The fire occurred in a Navy triple-arch magazine (encls 1-4). It was built in the 1943 to 1945 timeframe, based on Navy Bureau of Yards and Docks Drawing Number 217869. The facility consists of three separate earth-covered igloos/magazines with a common headwall and loading dock. Each magazine is concrete and arched along its long axis. Each has 4-foot wide double doors that open to a 6-foot wide concrete loading dock. The doors are wood, covered with 22-gauge metal. Each door has a hooded vent approximately 12 inches by 18 inches in the lower portion of the door. There is also a rear stack ventilator 15 inches in diameter and extending 30 inches above the earth cover. The ventilator stack is covered with a vent cap made of glazed ceramic, metal, and screening. It sets on top of the stack, but is not fastened to the stack. It weighs 195 pounds. The magazine is 80 feet long, 25 feet wide, and 12 feet high at the top of the arch. The magazines are separated by 13 feet of earth to a height of 6 feet above floor level. It then decreases to not less than 2 feet of earth cover which continues over the magazine roof. The headwall is 8 inches thick and is constructed of reinforced concrete. There are two sets of railroad tracks in front of the loading dock. The metal portions of the magazine are bonded and grounded. The railroad tracks are also bonded and grounded. There is no lightning protection system.

3. Events surrounding the fire:

a. Prior to fire:

(1) The magazine was entered on 15, 17, 25, and 27 July 1989 during the performance of a location survey by the Day and Zimmermann - Basil (DZB) Inventory Division. Nothing unusual or out of the ordinary was noted.

(2) The bonding and grounding system of the magazine was checked on 16 March 1989. The readings were 5.9 ohms for the building ground and 0.1 ohms for bonding of metal bodies. This is within the values permitted by

AMCR 385-100, Safety Manual, 1 August 1985, and DOD 6055.9-STD, Department of Defense Ammunition and Explosives Safety Standards, July 1984. There is no lightning protection system, and none is required where all metallic parts are bonded and grounded.

(3) A thunderstorm passed through the area at approximately 2300 the night prior to the fire (approximately 10 hours prior to the fire).

(4) A work crew drew keys for Magazines 116-10 through 116-20 on the morning of the fire. They were performing maintenance on magazine doors. The crew was on the loading dock of an adjacent magazine (116-12) at the time of the fire. They were scheduled to start work on Magazine 116-14 within an hour.

(5) There were no outstanding safety-related work orders or known safety deficiencies for Magazine 116-14-E.

b. During the fire:

(1) The fire was initially observed by a work crew on an adjacent magazine dock (Magazine 116-12) and two DZB safety personnel near Magazine 116-40 while returning from the Western Area Demil Facility (WADF). Magazine 116-40 is located approximately 1,300 feet from Magazine 116-14. They first observed sparks, fire, and smoke coming from the door ventilators and smoke coming from the rear ventilator. The volume of fire and smoke coming from the ventilator then increased significantly. This was followed by a "rush of air", with the doors being pushed open and the rear ventilator cap being "blown off". The very intense burning continued for approximately 3 minutes and then decreased significantly. During this period of decreased burning, several loud "bangs" were heard.

(2) The fire was reported by the work crew and the DZB safety engineers. The fire department, security, and other personnel responded. Road blocks were established around the edge of the magazine area. No attempt was made to enter the area or fight the fire. It was permitted to burn itself out.

c. Events following the fire:

(1) The area was secured, and a fire watch was posted. An Army EOD team from Sierra Army Depot entered the magazine the next morning. They determined that all the propellant had been consumed by the fire and that the magazine could be safely entered. This was the first entry made following the fire.

(2) The Government Safety Manager and DZB plant photographer then entered the magazine to make an initial assessment and take photographs.

(3) A local investigation was initiated with technical assistance provided by Mr. Robert Loyd, U.S. Army Armament, Munitions and Chemical Command (AMCCOM) Safety Office.

4. Description of magazine contents: The magazine contained 30,715 pounds of energetic material. All items were hazard class 1.3 (mass fire), and were awaiting disposal instructions. All items were in storage compatibility group Most items were stored on Navy metal pallets with the remaining few items store on wooden pallets. There was also a small quantity of wood used for blocking and bracing. The following items were stored in Magazine 116-14-E:

a. 81mm mortar increment bags; NSN 1315-00-425-0725; DODIC C020; quantity 237,084; net explosive weight (NEW) per item - 0.03 pounds; total explosive weight - 7,113 pounds; and stored in wooden boxes similar to those shown in enclosure 5. The increment bags were from a Marine Corps renovation job. The following lots were involved:

HEP-66803
CIL-68549
CIL-68550
CIL-68553
HEP-68247
HEP-68962
HEP-68963
RAD-67251
RAD-67572
RAD-67610
RAD-67611
Mixed Lot (derived from lots RAD-67610 and RAD-67611)

b. 5-inch, 54-caliber propelling charge (cased with plug); NSN 1320-00-039-3353; DODIC D305; quantity - 5; NEW per item - 18.6 pounds; total explosive weight - 93 pounds; and stored in metal shipping containers similar to those shown in enclosure 6. The propelling charge lot number, with the corresponding index number and propellant lot number is listed below.

BV-25X-C-60 APDF-10395 IHBF-19

c. 5-inch, 54-caliber propelling charge (cased with plug)
NSN 1320-00-879-3925; DODIC - D324; quantity - 125; NEW per item - 21.0 pounds; total explosive weight - 2,625 pounds; and stored in metal shipping containers similar to those shown in enclosure 6. The propelling charge lot number, with the corresponding index number and propellant lot number, is listed below:

BV-13-SB-69 SPDF-10980 unknown

d. 6-inch, 47-caliber propelling charge (cased with plug); NSN 1320-00-009-0352; DODIC D370; quantity - 4; NEW per item - 33.882 pounds; total explosives weight - 136 pounds; and stored in metal shipping containers. The propelling charge lot numbers, with the corresponding index numbers and propellant lot numbers, are listed below:

CH-114-Y-72	SPDN-7288	NHCDCD-83
CH-115-Y-72	SPDN-7288	NHCDCD-83
CH-116-Y-72	SPDN-7288	NHCDCD-83
CH-118-Y-72	SPDN-7288	NHCDCD-83

e. 8-inch, 55-caliber propelling charge (bagged); NSN 1320-00-089-4275; DODIC D605; quantity - 433; NEW per item - 45.4 pounds; total explosive weight - 19,658 pounds; and stored in metal shipping containers. The propelling charge lot numbers, with the corresponding index numbers and propellant lot numbers, are listed below:

DG-1-HA-52	SPDW-10113	IHDD-104
DG-1-HA-53	SPDW-10109	IHDD-109
DGR-1-CO-69	SPD-9070	IHDD-86
DGR-10-CO-67	SPD-8862	IHDD-?
DGR-6-C-51	SPDN-8521	IHDD-75
DGR-6-CO-67	SPD-8311	IHDD-73
DGO-6-CO-69	SPD-8520	IHDD-74
DGR-6-YO-67	SPD-9711	IHDD-94
DGR-8-CO-68	SPD-8664	IHDD-77
DGR-1-HAW-55	SPDN-6359	IHDD-47
DGR-11-CO-68	SPD-7843	IHDD-64
DGR-13-CO-68	SPD-6990	IHDD-51
DGR-14-CO-68	SPD-8521	IHDD-75
DGR-3-YO-67	SPDN-7499	IHDD-60
DGR-5-CO-67	SPDN-6082	IHDD-44
DGR-8-C-51	SPD-3288	IHDD-34
DGR-8-CO-69	SPD-5409	IHDD-41
DGR-5-CO-69	---	---

f. 8-inch, 55-caliber propelling charge (bagged); NSN 1320-00-039-3814; DODIC D607; quantity - 15; NEW per item - 45.4 pounds; total explosive weight - 681 pounds; and stored in metal shipping containers. The propelling charge lot numbers, with the corresponding index numbers and propellant lot numbers, are listed below:

DG-1-SJ-68	SPD-9069	IHDD-35
DGR-6-C-51	SPD-8521	IHDD-75
DGR-8-CO-68	SPD-8664	IHDD-77
DG-2-CO-68	SPD-8664	IHDD-77

g. 8-inch, 55-caliber propelling charge (bagged); NSN 1320-00-089-3803; DODIC D608; quantity - 9; NEW per item - 45.4 pounds; total explosive weight - 409 pounds; and stored in metal shipping containers. The propelling charge lot numbers, with the corresponding index numbers and propellant lot numbers, are listed below:

DG-4-MCA-51	SPDG-9440	NCDD-100
DG-5-CD-68	SPDG-10905	unknown

5. Description of damage:

a. Propellant: The propellant in the magazine was totally consumed by the fire. Numerous unburned propellant grains were thrown out the door (encls 7 and 8).

(1) Bagged propelling charges: The 8-inch, 55-caliber bagged propelling charges were stored in metal shipping containers. The walls of the containers are made of light-gauge aluminum. The ends and lids are constructed of heavier gauge aluminum. Containers located near the rear of the magazine had substantial portions of the walls remaining, and most of the ends/lids remained intact (encl 9). The containers located in the center of the magazine had most of the wall missing, but most of the ends remained intact (encls 10-12). The containers located in the front left portion of the magazine (when facing to the rear) were almost totally destroyed (encl 13). Virtually none of the walls remained, and major portions of the ends/lids were destroyed. Aluminum slag was found on the floor. This indicates the aluminum was exposed to temperatures of more than 1,200 degrees Fahrenheit for a period of time sufficiently long to have become molten (encl 14). This was the only area this occurred in within the magazine. Small droplets of aluminum slag were also found outside of the magazine, directly in front of the doors (encl 15).

(2) Cased propelling charges: There were 134 cased propelling charges (5- and 6-inch). They were stored in metal shipping containers. Approximately 10 percent of them suffered a violent rupture of the metal casing. Most were located in the front left portion of the magazine (encls 16-19).

(3) Mortar increments: 81mm mortar increments were stored in wooden boxes. The boxes were totally consumed with only ash remaining (encl 20).

b. Structure:

(1) The doors were heavily damaged. The metal cladding of the doors remained attached to the hinges but was deformed by the heat. There was fracturing of the concrete around the hinges where they are attached to the headwall. The wood was ignited by the fire and continued to smolder until the next morning and was completely consumed. There was no damage to other magazines in the 116-14 facility (encls 21-24).

(2) There was moderate spalling of the concrete and very heavy smoke damage in the rear third of the magazine (encls 25, 9, and 26). There was heavy spalling of the concrete in the center to the front portion of the magazine on the right side. The 81mm mortar increments were stored in this area (encl 20). There was light to moderate smoke damage to the left front corner of the magazine (encls 18 and 19). There was localized spalling and smoke damage in other areas of the magazine, especially along the lower portions of the walls where propellant containers were close to the walls (encl 17). There was an indentation approximately 1-inch deep in the front wall near the side wall, which was caused by the impact of a 6-inch 47-caliber cased propelling charge. There was severe spalling on the exterior front wall opposite the impact. An area approximately 2 feet by 2 feet, several inches deep was damaged. The steel mesh (reinforcing bar) was exposed, and fragments were thrown across the entire width of the 6-foot loading dock (encls 23, 27, and 28).

(3) Railroad tracks: The two railroad tracks directly in front of the magazine were damaged. The track farthest from the dock received the heaviest

damage. Expansion of the rails from the heat, and later cooling, displaced the ties up to 4 inches on the long axis, 2 inches on the short axis, and 2-3 inches on the vertical axis. Numerous ties were severely charred (encls 29-32).

6. Discussion:

a. Deflagration versus detonation: A review of the fire scene and witness statements indicated a deflagration (or rapid burning) occurred rather than a detonation.

(1) There were 134 cased propelling charges (5- and 6-inch). Approximately 10 percent of them suffered a violent rupture of the metal casing (encls 17-19). A large quantity of the remaining cased propelling charges were scattered about the magazine. Some traveled more than 40 feet. Several 5-inch, 54-caliber case propelling charges exited the door and were found in front of the magazine near the railroad tracks (encls 29-34). One 5-inch, 54-caliber propelling charge (that had a violent rupture) was found approximately 295 feet from the headwall (near the next magazine row) (encl 33).

(2) A number of closing plugs for the cased charges were found inside and outside of the magazine. Several almost intact closing plugs were found in front of the magazine beyond the railroad tracks (encls 31, 35, and 36). This indicated they had been pushed out of the case as pressure built up in the case.

(3) Numerous unburned propellant grains were found outside the magazine (encls 7 and 8).

(4) There was an absence of cratering or significant damage to the floor and foundation of the magazine.

(5) There was no rupture of the magazine or displacement of the earth cover.

(6) All items stored in the magazine had a hazard class of 1.3 (mass fire).

(7) The rear ventilator cap weighting 195 pounds was found approximately 30 feet behind the magazine in soft sand. It was undamaged (encls 37-39).

b. Fire sequence: Based on the physical evidence and witness statements, the fire appears to have started in the front left portion of the magazine in 8-inch, 55-caliber bagged propelling charges. This caused smoke and sparks to come out of the door vents and smoke out of the rear ventilator. The fire then spread to the 81mm mortar increments and remaining 8-inch, 55-caliber bag charges. As the propellant burned, the pressure increased causing the rear ventilator cap to pop off and the doors to open. This produced the large tongue of flame that came out of the doors and rear ventilator. The sage brush in front of the magazine was burned for a distance of approximately 135 feet with a burn pattern of approximately 45-degree radiating from the door (encls 1, 2, 35, and 40).

The 5-inch, 54-caliber and 6-inch, 47-caliber cased propelling charges started to deflagrate during the initial fire ball and continued after the fireball had subsided. They were stored in aluminum shipping containers with tight fitting lids.

c. Fire department: The fire department and other emergency personnel responded, but no attempt was made to fight the fire. It was permitted to burn itself out and cool overnight. A fire watch was posted.

d. Navy propellant - general:

(1) Smokeless powder is the propellant used in propelling charges of Navy gun ammunition. The 8-inch propelling charges use a single-base propellant with nitrocellulose (NC) as the main ingredient. It is colloided with ether and alcohol. A small quantity of diphenylamine stabilizer is added to assist in preserving the stability of the propellant. The proportion of diphenylamine is usually 0.5 to 1.0 percent. It is referred to as SPD propellant with the "SP" indicating single-base smokeless powder and "D" indicating diphenylamine stabilizer. Lots which have been reworked are indicated by a "W", and lots with material added to reduce the absorption of moisture are indicated by an "N".

(2) Decomposition: There are many factors which affect the decomposition of propellant during storage - high temperature, moisture, and age being the most important. The internal oxidation gives rise to the evolution of nitrogen dioxide (NO_2) which, in turn, oxidizes and denitrates the propellant, producing more NO_2 and heat, causing further oxidation and denitration, etc. Thus, the reaction is self-perpetuating or autocatalytic. If the NO_2 produced could somehow be removed, then the decomposition would continue at a slow, even rate. If, however, it is not removed, the propellant can rapidly reach its ignition temperature. This results in either a violent burning or deflagration results depending on the degree of confinement of the resulting gases.

(3) Stabilizer: To minimize these effects and thereby reduce the safety hazard of propellant and increase their shelf life, stabilizer is added to the propellant. Diphenylamine is used as a stabilizer primarily for single-base propellant. The diphenylamine combines with the NO_2 , effectively removing it and drastically reducing the rate of decomposition. This permits the decomposition to continue at a slow, even rate. There are only a limited number of reaction locations on each of the stabilizer molecules to absorb the oxides of nitrogen. Therefore, stabilization is only effective until the material is saturated. Afterward, the decomposition of NC can proceed essentially as with unstabilized material, to the point of risk of autoignition.

(4) 1988 Navy Gun Propellant Safety Surveillance Annual Report: The report is prepared by the Naval Ordnance Station, Indian Head, Propellant Group. The report contains the following two statements:

(a) "Pyro (SPD, SPDF, SPDW, and SPDB) propellants have a safe shelf age between 30 and 40 years, decreasing with age. Many of these propellant lots have passed their predicted safe shelf life which means there is a greater than 5-percent chance that they will be condemned." (Note: The actual

recommendation to dispose of a propellant lot is only made after a lot fails the oven test. The sample of propellant is stored at 65.5 degrees Celsius. When it fumes in 30 days or less, the lot is considered to have failed the test.)

(b) "We have not yet established a definite relationship between the quantity of stablizer remaining in a sample of propellant and the length of safe shelf life expectancy, between days to fume and remaining stabilizer content."

(5) Lot number: Smokeless powder index numbers are assigned serially to smokeless powder (propellant) that has been manufactured and proofed. The numbers aid in the identification of each index and also give an approximate indication as to the age of the propellant. A propellant lot number is also assigned to identify the manufacturing facility. When the propellant is used in the assembly of propelling charges, a separate propellant lot number is also assigned. One propellant index number can be used in several propelling charge lots.

e. Navy Propellant - Magazine 116-14-E:

(1) Propelling charge lots DG-2-CO-68, DGR-1-HAW-55, DGR-11-CO-68, DGR-13-CO-68, DGR-14-CO-68, DGR-5-CO-69, and DGR-8-C-51 were identified as having low stablizer content. It ranged from 0.04 to 0.13 percent stabilizer content. Disposal was directed by Navy Notices of Ammunition Reclassification (NARs) 645-87, 1020-87, 597-88, and 598-88 and Army ammunition information notice (AIN) 12-88. When stabilizer content reaches 0.20 percent, disposal of the propellant is normally recommended.

(2) Information provided by Naval Ordnance Station, Indian Head, MD, Propellant Group, to Naval Weapons Support Center Crane, Code PM4, and to the AMCCOM Safety Office (10 August 1989) indicated the following data on "Last Fume Date/Days to Fume" for the following propelling charge lots: DGR-8-CO-68 - no data; DGR-1-HAW-55 - day 221 of 1989/255 days; DGR-11-CO-68 - day 89 of 1989/252 days; DGR-13-CO-68 - day 114 of 1989/172 days; DGR-14-CO-68 - day 84 of 1989/239 days; DGR-3-YO-67 - 173 of 1986/23 days; DGR-5-CO-69 - day 94 of 1989/229 days; and DGR-8-CO-69 - day 192 of 1984/14 days. Disposal of lots DGR-3-YO-67 and DGR-8-CO-69 was directed by NARs 645-87 and 597-88, respectively.

(3) At least two of the propelling charge lots have propellant that was used in several lots. This is indicated by a common index number. For example, propelling charge lot DCR-8-CO-68 has the same index number (8664) as lots DGR-8-CO-68 and DG-2-60-68, and propelling charge lot DGR-14-CO-68 has the same index number (8521) as lot DGR-6-C-51.

f. Disposal actions: Hawthorne AAP submitted a request to the State of Nevada for permission to open burn/open detonate a quantity of propellant identified as having low stabilizer content. Part of the material stored in Magazine 116-14E was included in the request. The request was denied. The denial was based, in part, on the fact that the stabilizer tests were conducted on material not stored at Hawthorne AAP; these tests did not correctly reflect the condition of material stored under ideal conditions at Hawthorne AAP.

g. Potential causes: At the beginning of the investigation, a variety of fire causes was considered. They included electrical malfunction; mechanical malfunction; sabotage/arson; lightning; careless smoking; flammable liquids or gases; friction; high ambient temperature in the magazine; and spontaneous combustion. Other causes were not considered due to the absence of any evidence which would support such a determination.

h. Discounted causes: The following causes were considered, but were discounted, based on the available evidence:

(1) Electrical malfunction: There was no electrical service to the magazine.

(2) Mechanical malfunction: There was no permanent or temporary mechanical equipment in the magazine, including material handling equipment.

(3) Sabotage/Arson: The Hawthorne AAP Government security staff determined there was no sabotage/arson. Additionally, the latch was found to still be through the hasp and secured with a Navy padlock (encl 41).

(4) Lightning: A thunderstorm moved through the Hawthorne AAP area at approximately 2100, 8 August 1989. There was more than a 10-hour gap between the storm and the fire. There was no evidence of lightning strikes in and around Magazine 116-14 and adjacent magazines. The bonding and grounding system of the magazine and adjacent railroad tracks was checked on 16 March 1989. The readings were 5.9 ohms for the building ground and 0.1 ohms for bonding of metal bodies. This is within the values permitted by AMCR 385-100 and DOD 6055.9-STD. There is no lightning protection system. A check of the system after the fire revealed no problems or abnormal readings. The readings were 3.6 ohms for the building ground and 0.1 ohms for bonding of metal bodies. The rear vent cap showed no signs of a lightning strike, fire damage, or smoke damage.

(5) Careless smoking: There was no evidence of discarded smoking materials or matches. The entire area is a "no smoking" area.

(6) Flammable liquids and gases: There was no evidence of flammable liquids or gases being used or stored in or around the magazine.

(7) Friction: There was no mechanism present to cause friction.

(8) High ambient magazine temperature: There is no indication of high temperatures in the magazine prior to the fire. A recording thermometer was located in Magazine 116-14-A. It indicated a high temperature of 78 degrees Fahrenheit when checked after the fire.

(9) Spontaneous ignition of 81mm mortar increments: The 81mm mortar lots had stabilizer contents ranging from 0.40 to 0.80 percent based on information provided by the AMCCOM Product Assurance Directorate.

(10) Spontaneous ignition of 5- and 6-inch propelling charges: There was no indication of low stabilizer in the 5-inch, 54-caliber and 6-inch, 47-caliber cased propelling charges.

1. Most probable cause: Spontaneous ignition of 8-inch, 55-caliber bagged propelling charges located in the front left portion of the magazine is the most probable cause. This was due to the loss of stabilizer and subsequent increase in rate of decomposition. This is based on the physical evidence and witness statements.

(1) Propelling charge lots DG-2-CO-68, DGR-1-HAW-55, DGR-11-CO-68, DGR-13-CO-68, DGR-14-CO-68, DGR-5-CO-69, and DGR-8-C-51 were identified as having low stabilizer content. They were located in the left front portion of the of the magazine. It ranged from 0.04 to 0.13 percent stabilizer content. Disposal was directed by Navy NARs 645-87, 1020-87, 597-88, and 598-88 and Army AIN 12-88. When stabilizer content reaches 0.20 percent, disposal of the propellant is normally recommended.

(2) The heaviest fire damage was located in the front left corner of the magazine where the 8-inch, 55-caliber propelling charges were located. The 8-inch, 55-caliber bagged propelling charge containers were stored in aluminum shipping containers. The walls are made of light-gauge aluminum. The lids and ends are constructed of heavier gauge aluminum. The containers located near the front, to the left of the door, were almost totally destroyed. Virtually none of the walls remained, and major portions of the ends/lids were destroyed. Aluminum slag was found on the floor. This indicates the aluminum was exposed to temperatures of more than 1,200 degrees Fahrenheit for a period of time sufficiently long to have become molten. This was the only area this occurred in.

(3) Containers of 8-inch, 55-caliber bagged propelling charges located near the rear of the magazine had substantial portions of their walls remaining. Most of the ends/lids remained intact, as they were constructed of heavier gauge metal. The containers located in the center of the magazine had most of the wall missing, but most of the ends remained intact.

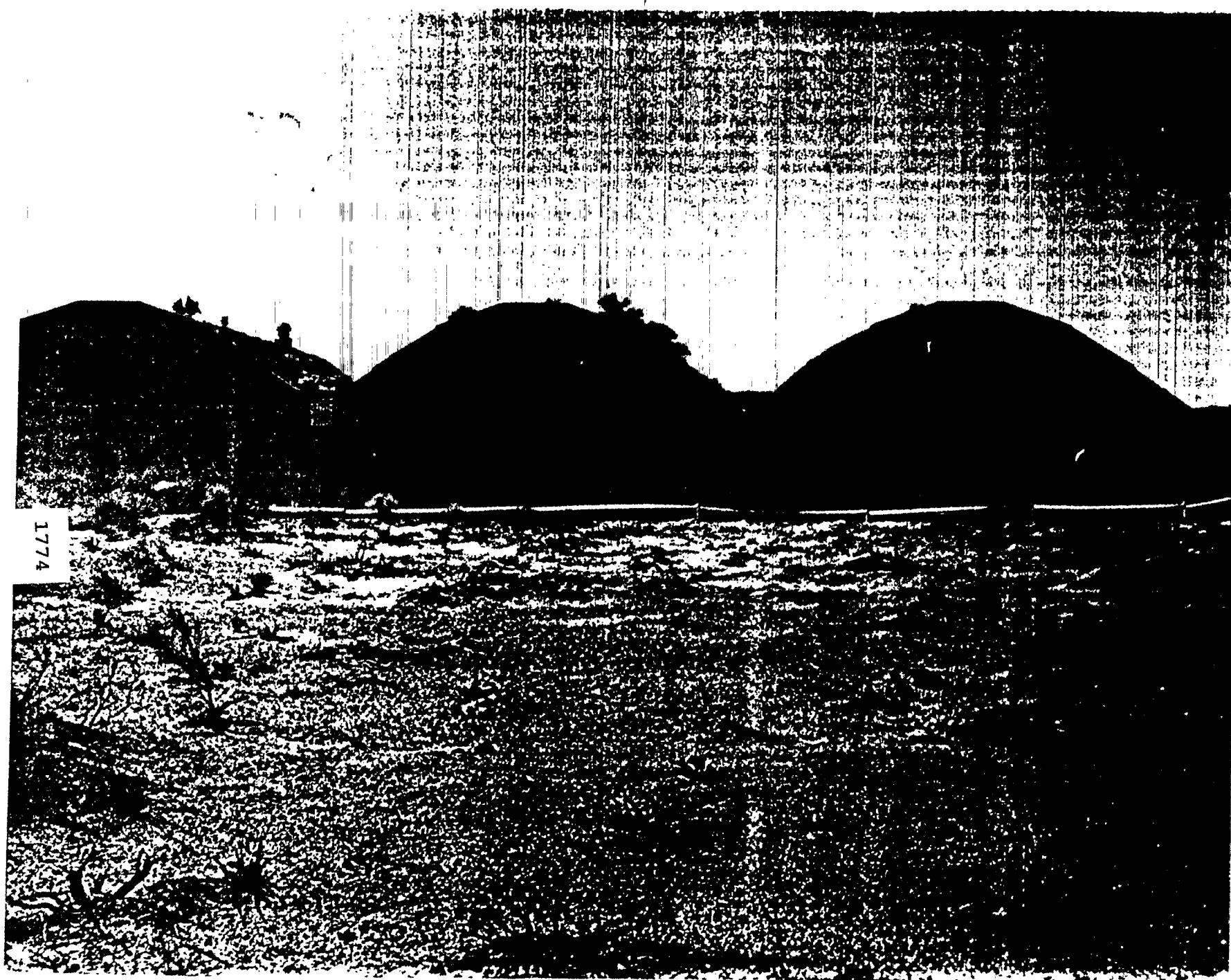
(4) Witnesses indicated they first observed sparks/fire and smoke coming from the door ventilators and smoke coming from the rear ventilator. This was followed by a "rush of air", the doors being pushed open, and the rear ventilator cap being blown off. A jet of flame came from the doors burning the sage brush. A smaller jet of flame came from the rear ventilator and was described as looking like "a rocket taking off". The very intense burning continued for approximately 3 minutes and then decreased significantly. During this period of decreased burning, several loud "bangs" were heard. These were apparently 5-and 6-inch cased propelling charges deflagrating. This delayed deflagration can be attributed to the fact that the cased charges had a closing plug and were stored in metal shipping containers. This provided some insulation from the heat generated by the initial fireball.

7. Conclusions:

a. When the heat generated by the decomposition was added to the system and combined with the increased pressure within a sealed shipping container, the stabilizing capacity of the remaining diphenylamine was overwhelmed, and the autoignition temperature of the propellant was reached. The result was a violent reputure and deflagration of the propellant stored in Magazine 116-14E.

b. Based on the available evidence, the most probable cause of the fire was the spontaneous ignition of 8-inch, 55-caliber bagged propelling charges due to the loss of stabilizer and subsequent increase in rate of decomposition occurring in one of the lots located in the left front portion of the magazine. They were propelling charge lots DGR-2-C-68, DGR-1-HAW-55, DGR-11-CO-68, DGR-13-CO-68, DGR-14-CO-68, DGR-5-CO-69, and DGR-8-C-51.





1774

1775



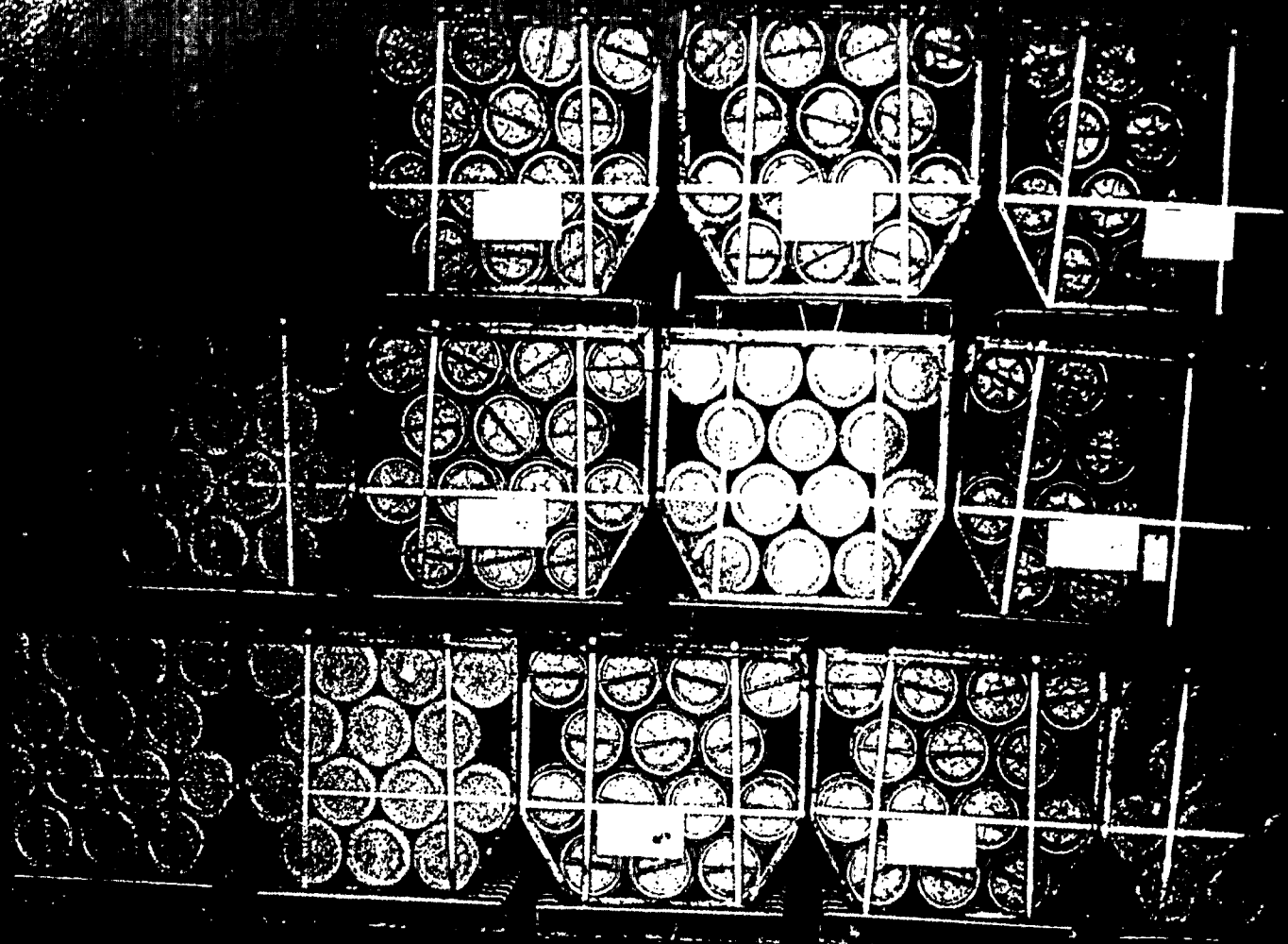
1776





1778

6

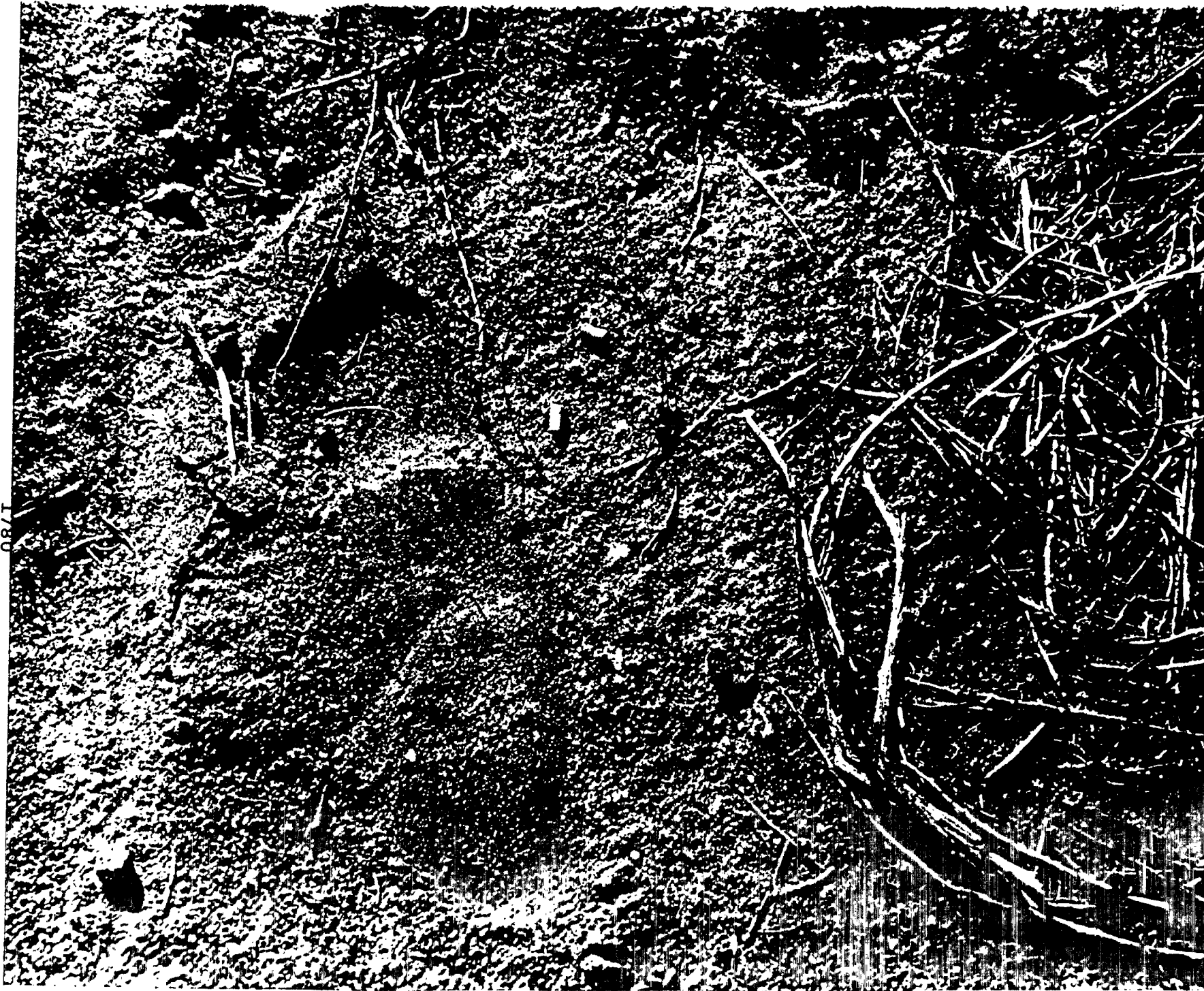


1778

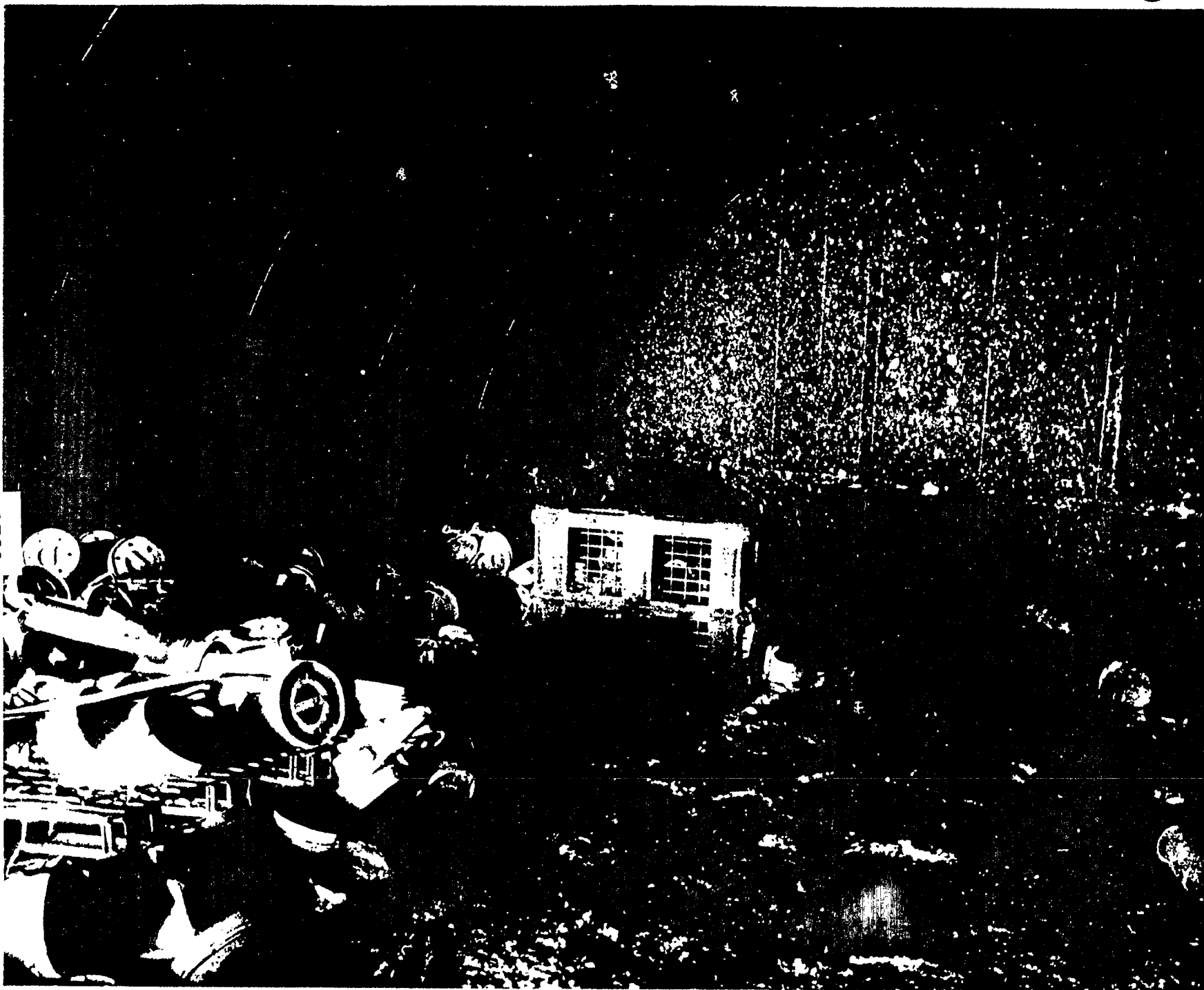


1779

08/1



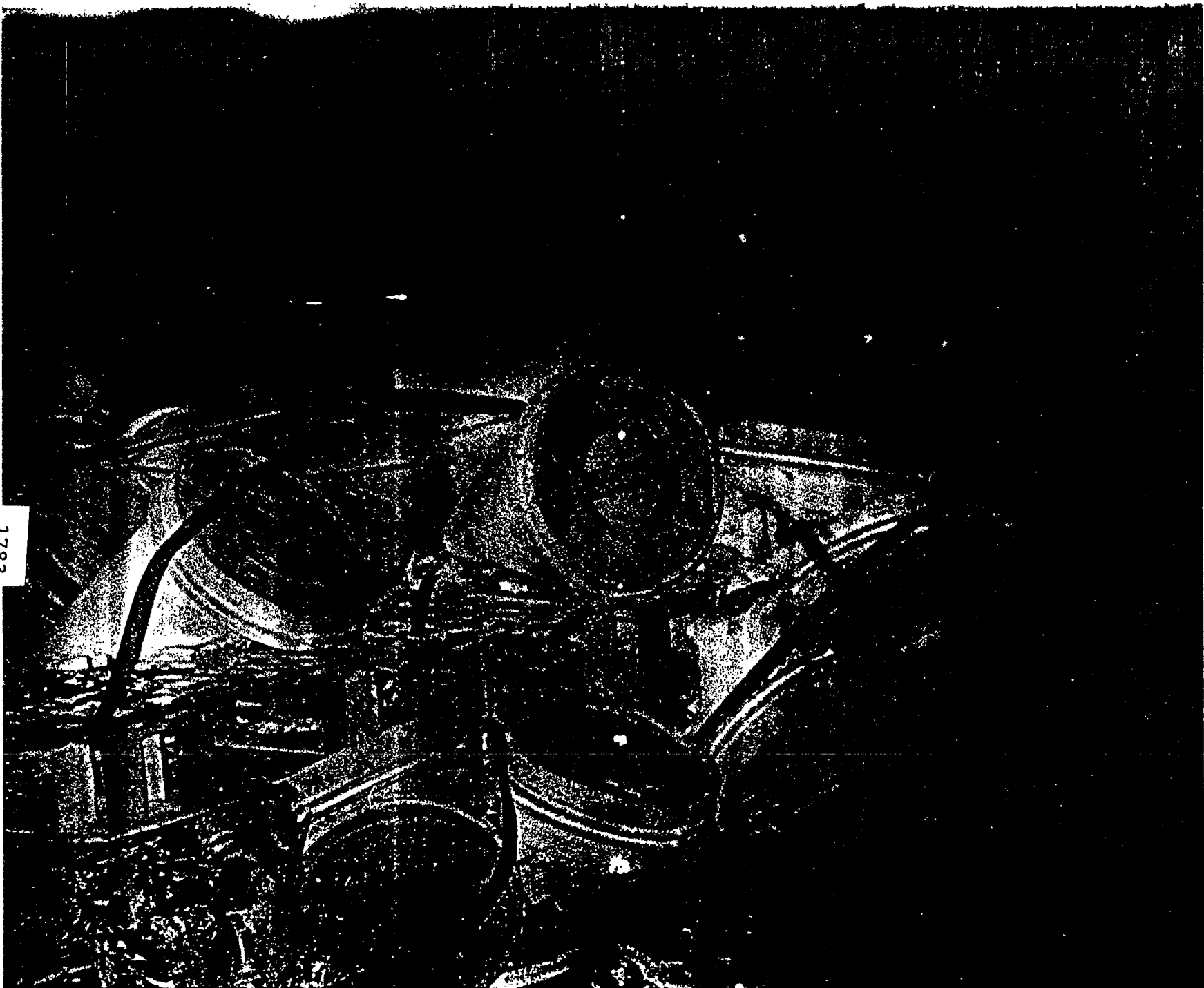
1781





1782

1783

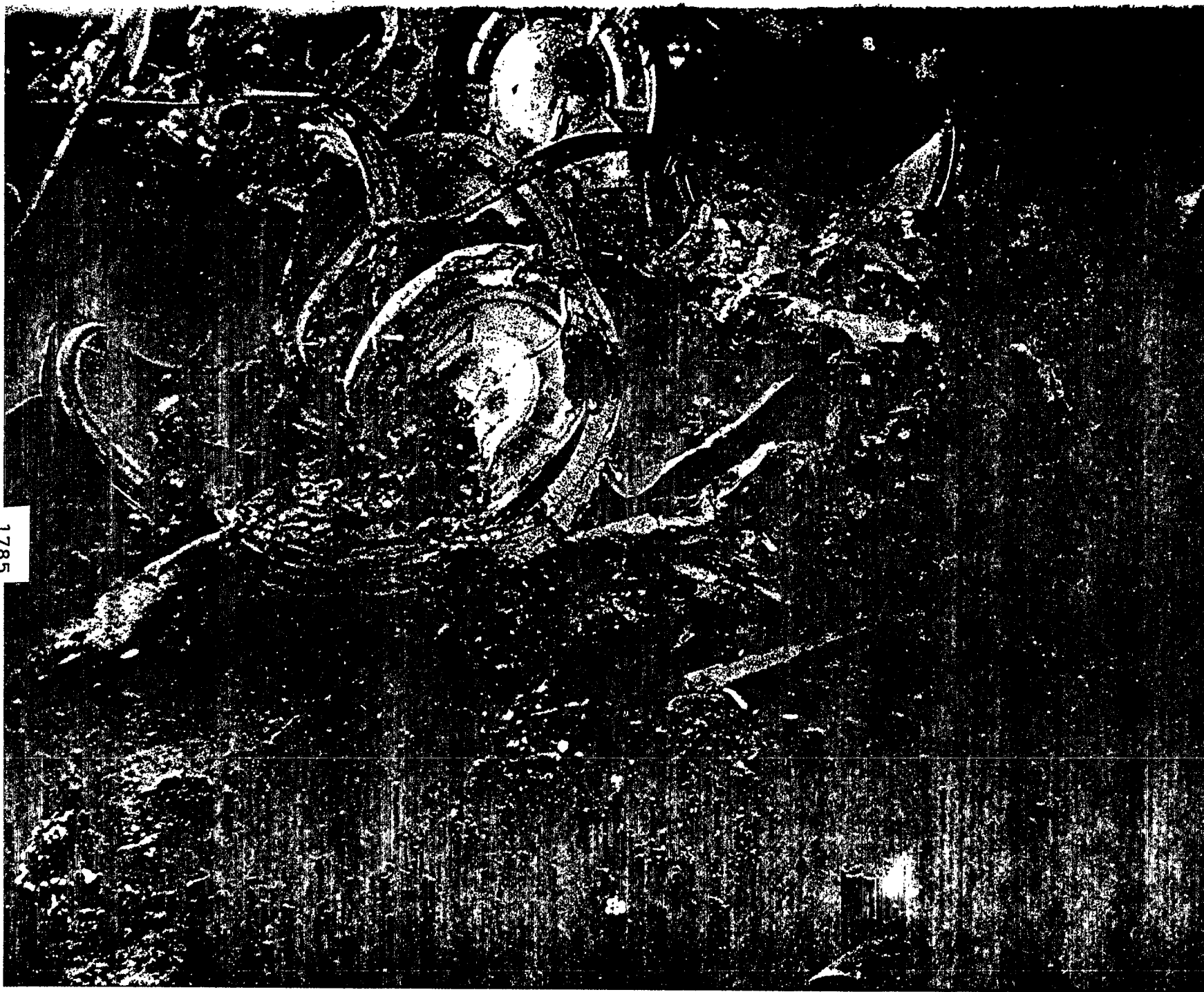




1784

12

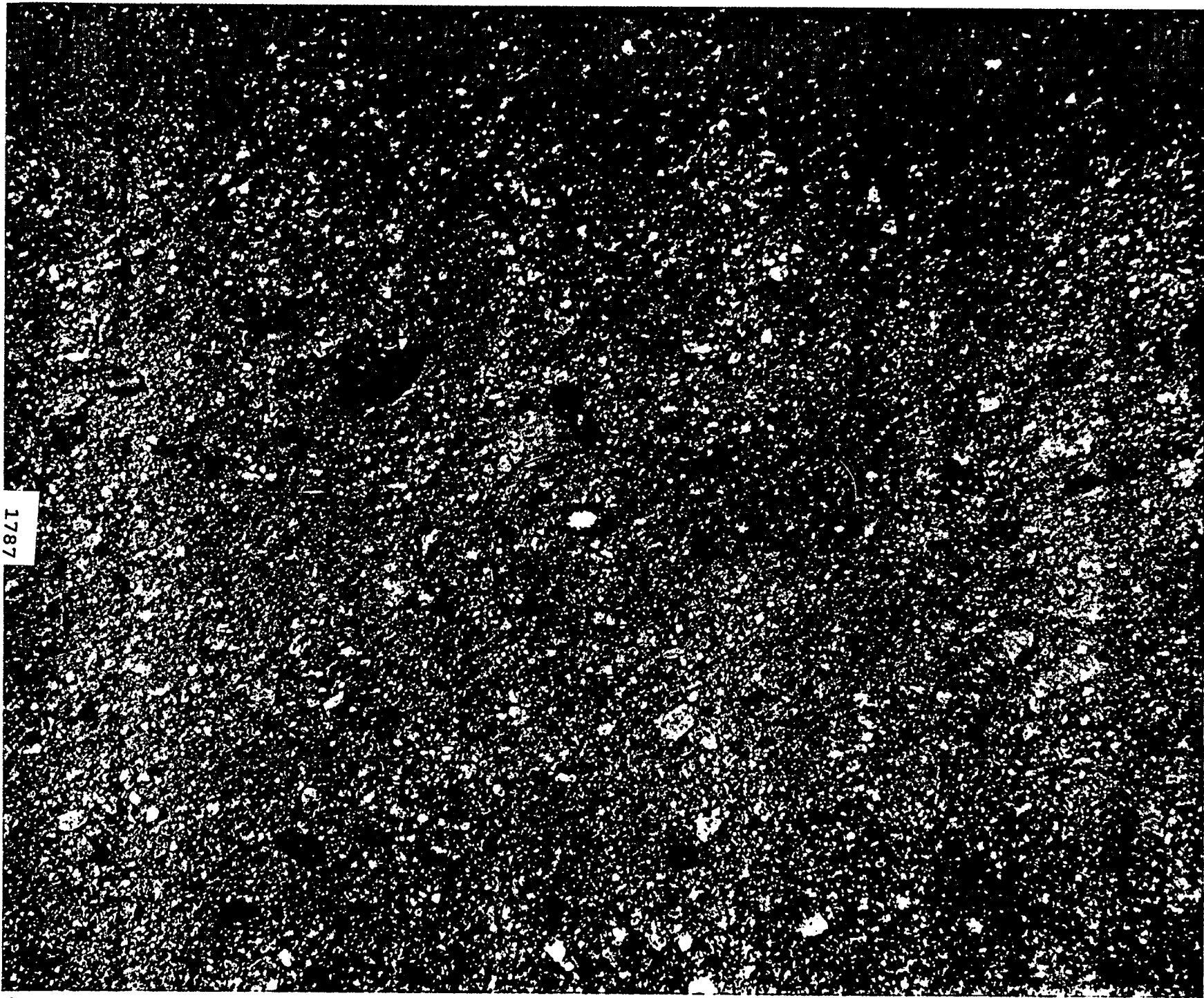
1785





1786

14



1787

91

88/T







1790

18

1791



20

1792



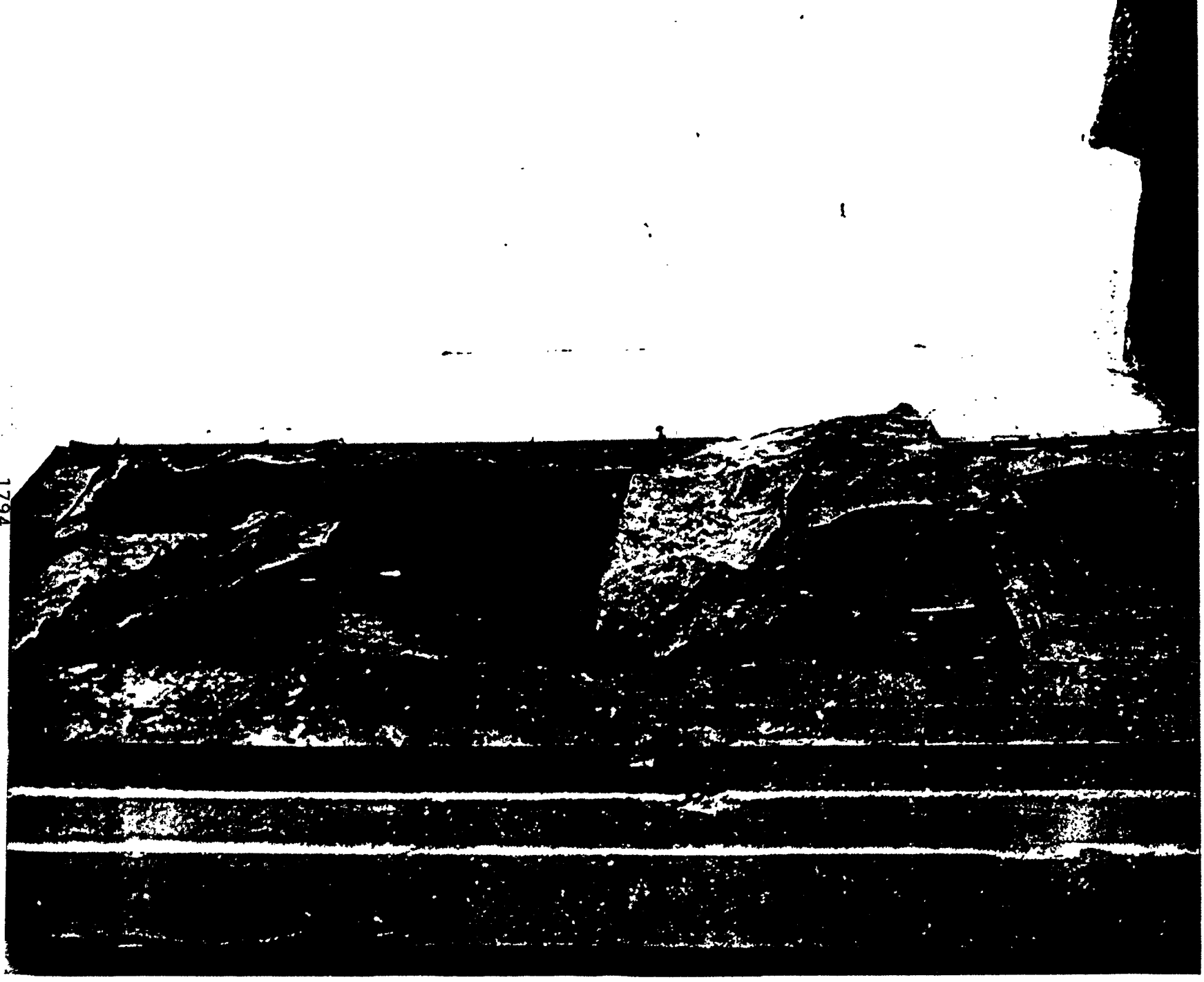


1793

21

22

1794



1795

23



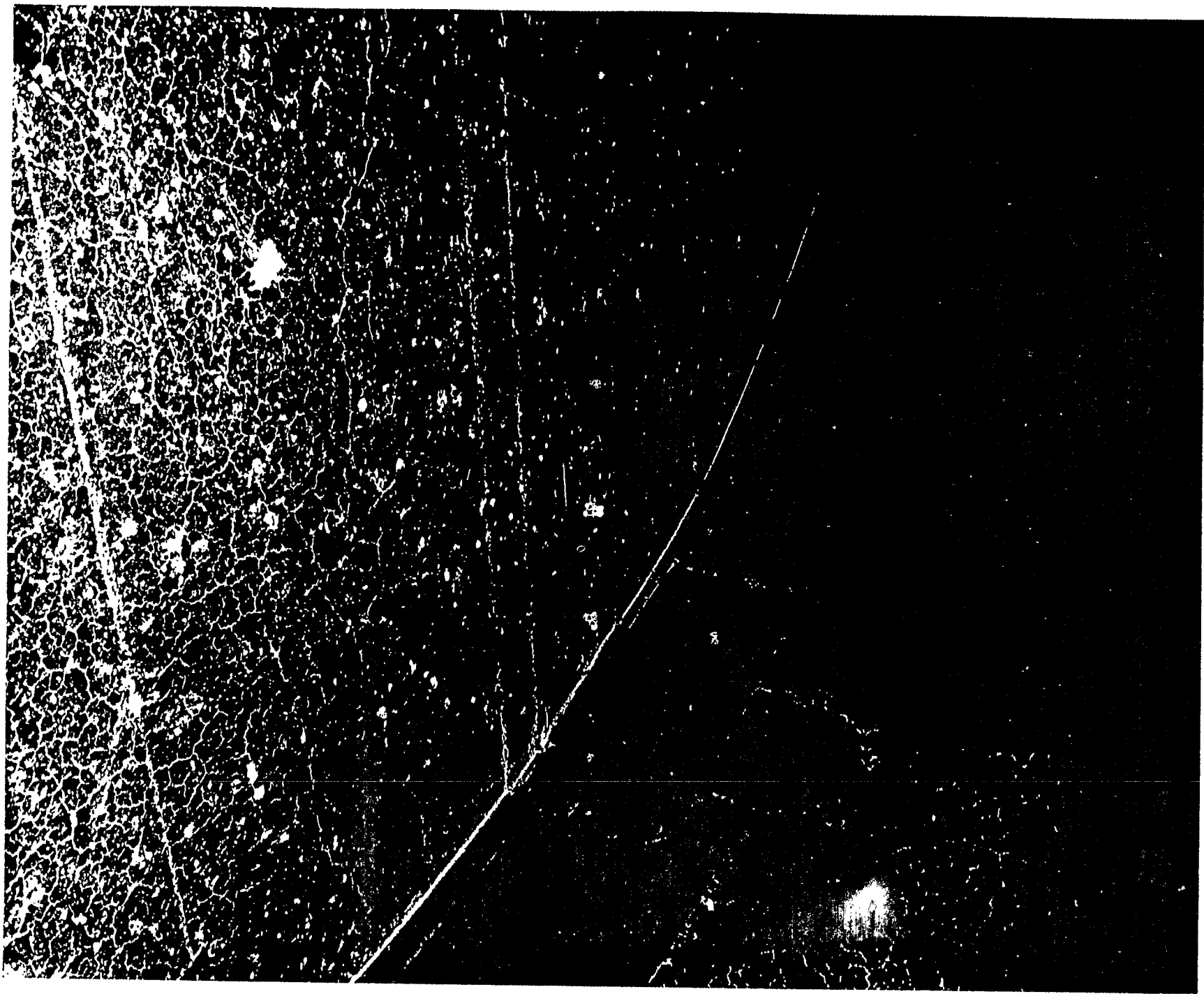
24

1796



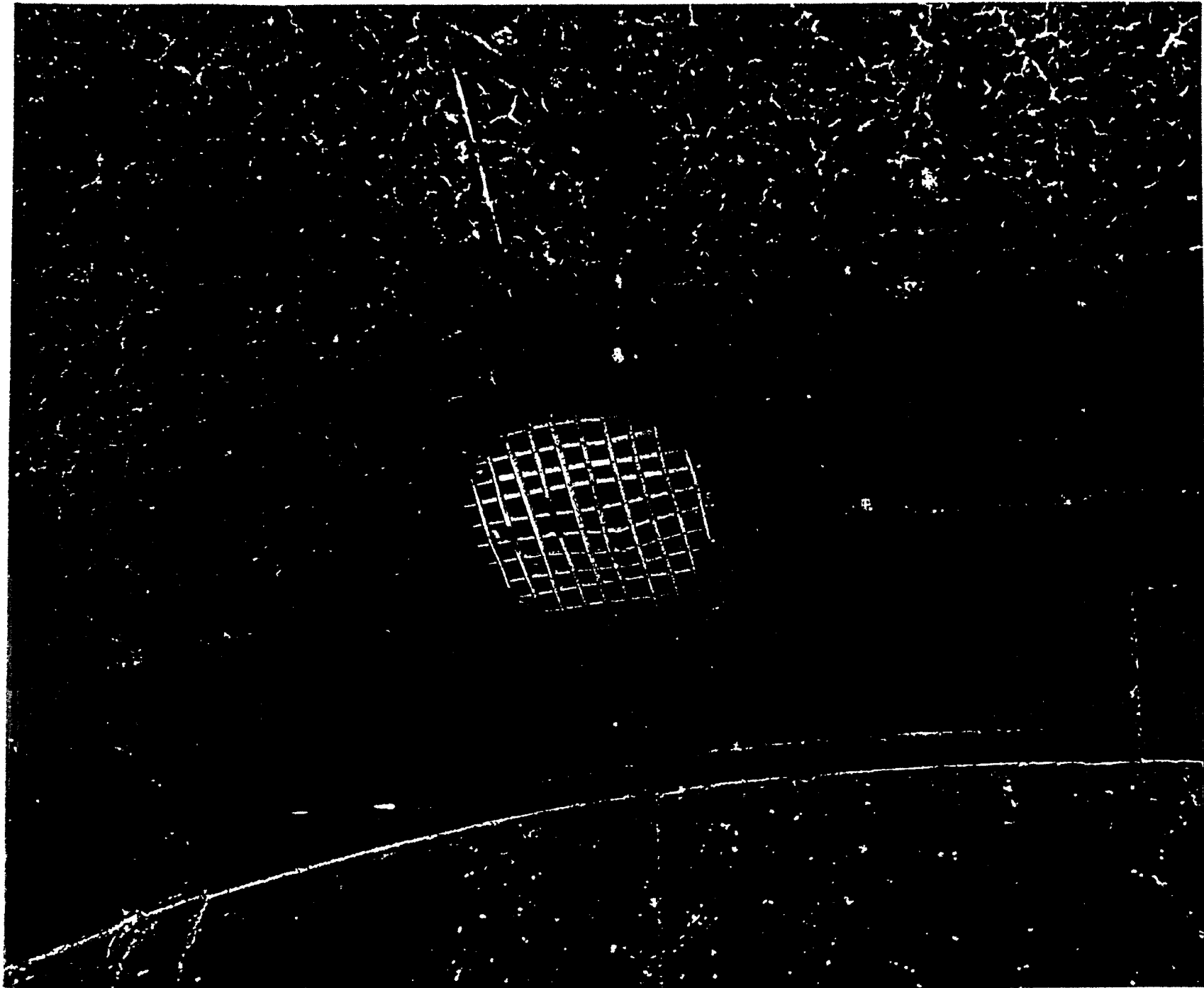
25

1797



26

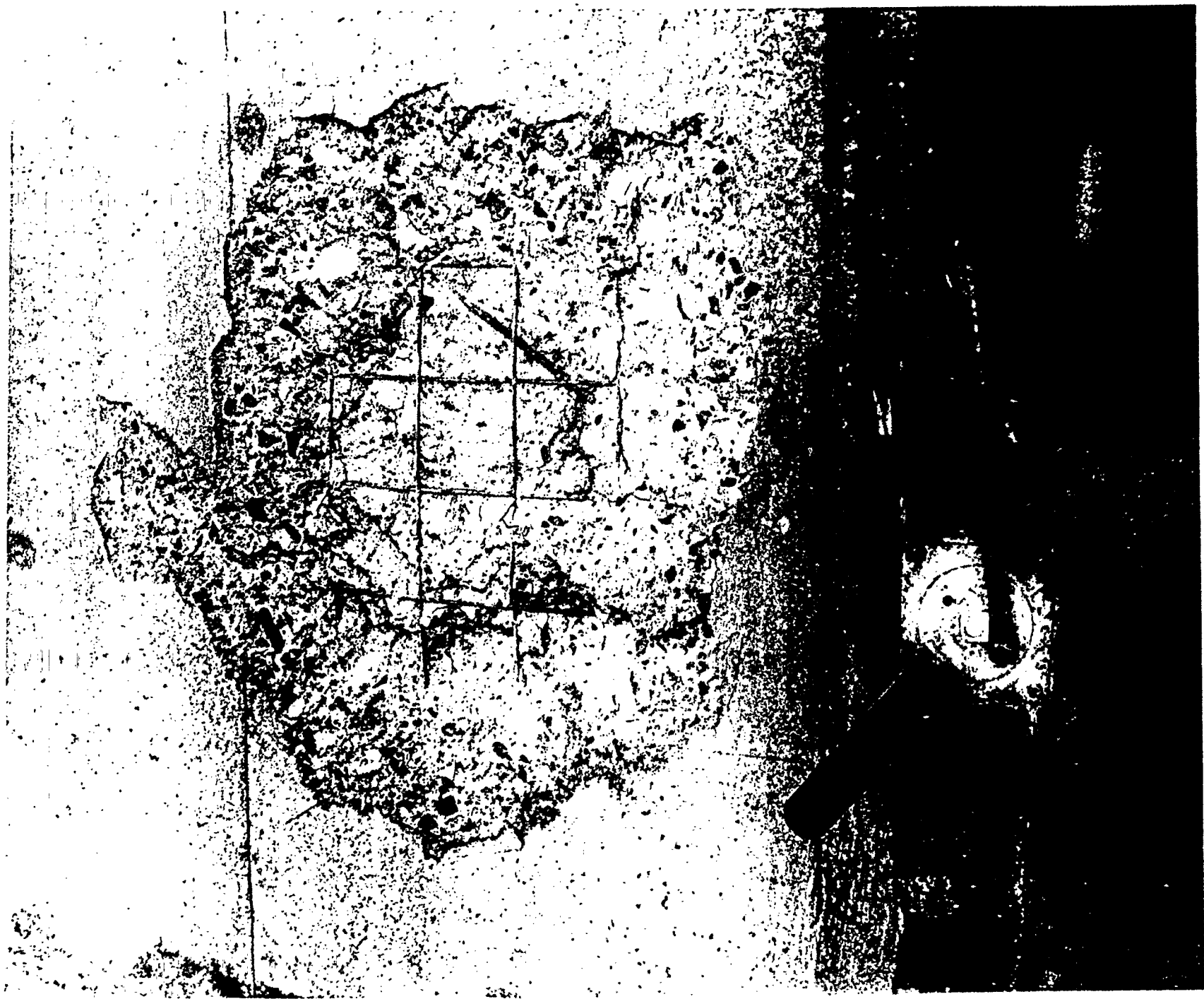
1798



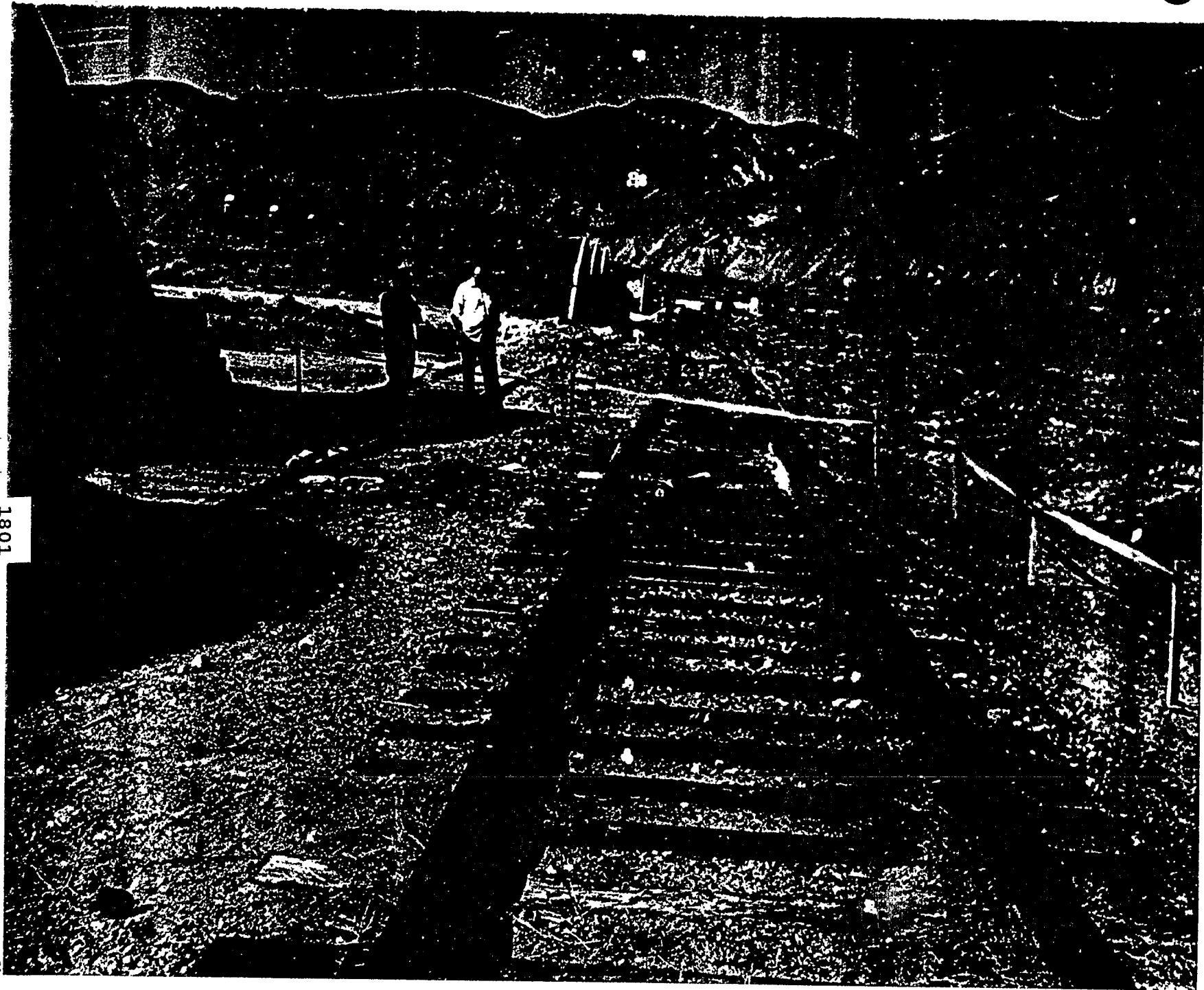


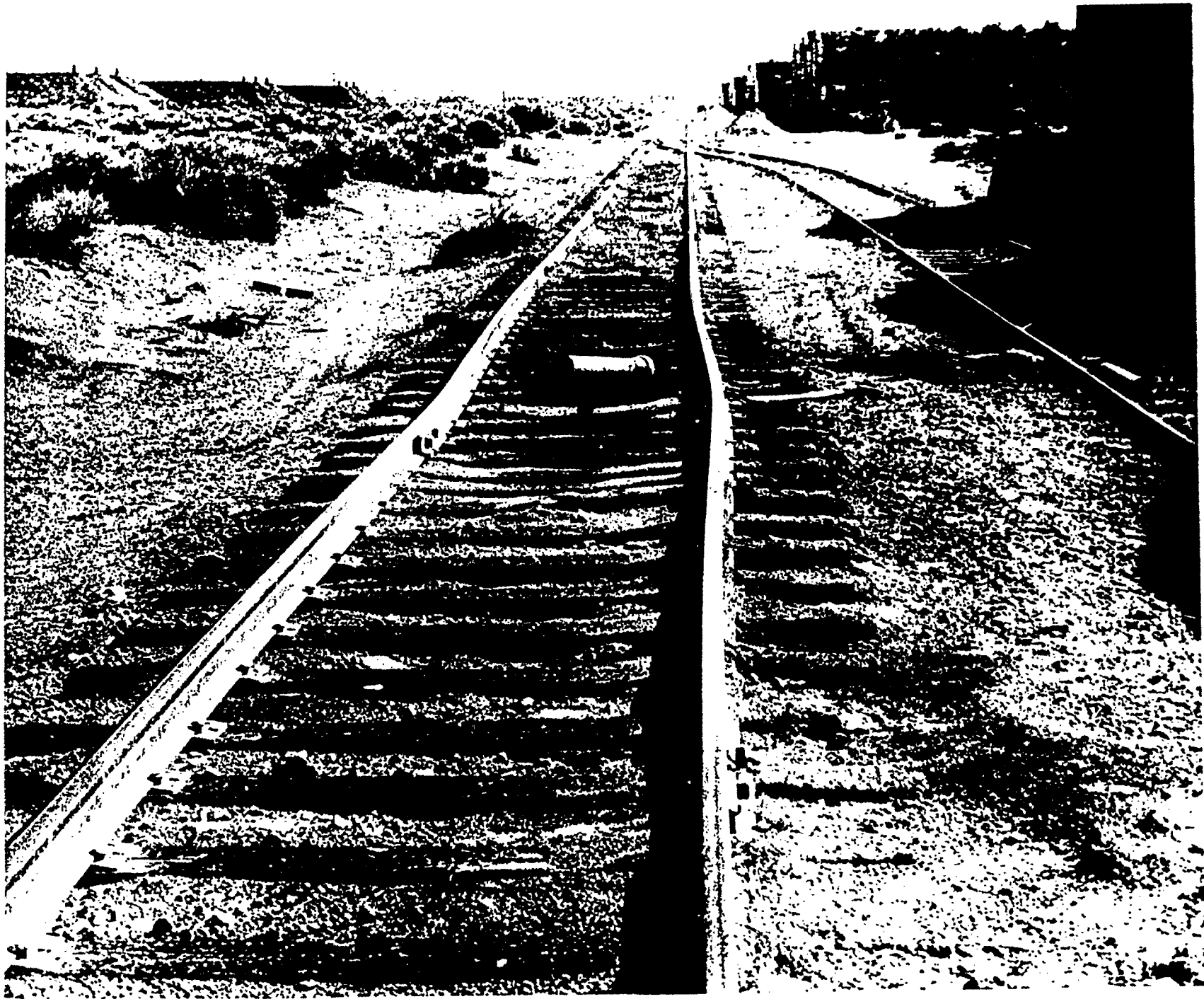
28

1800



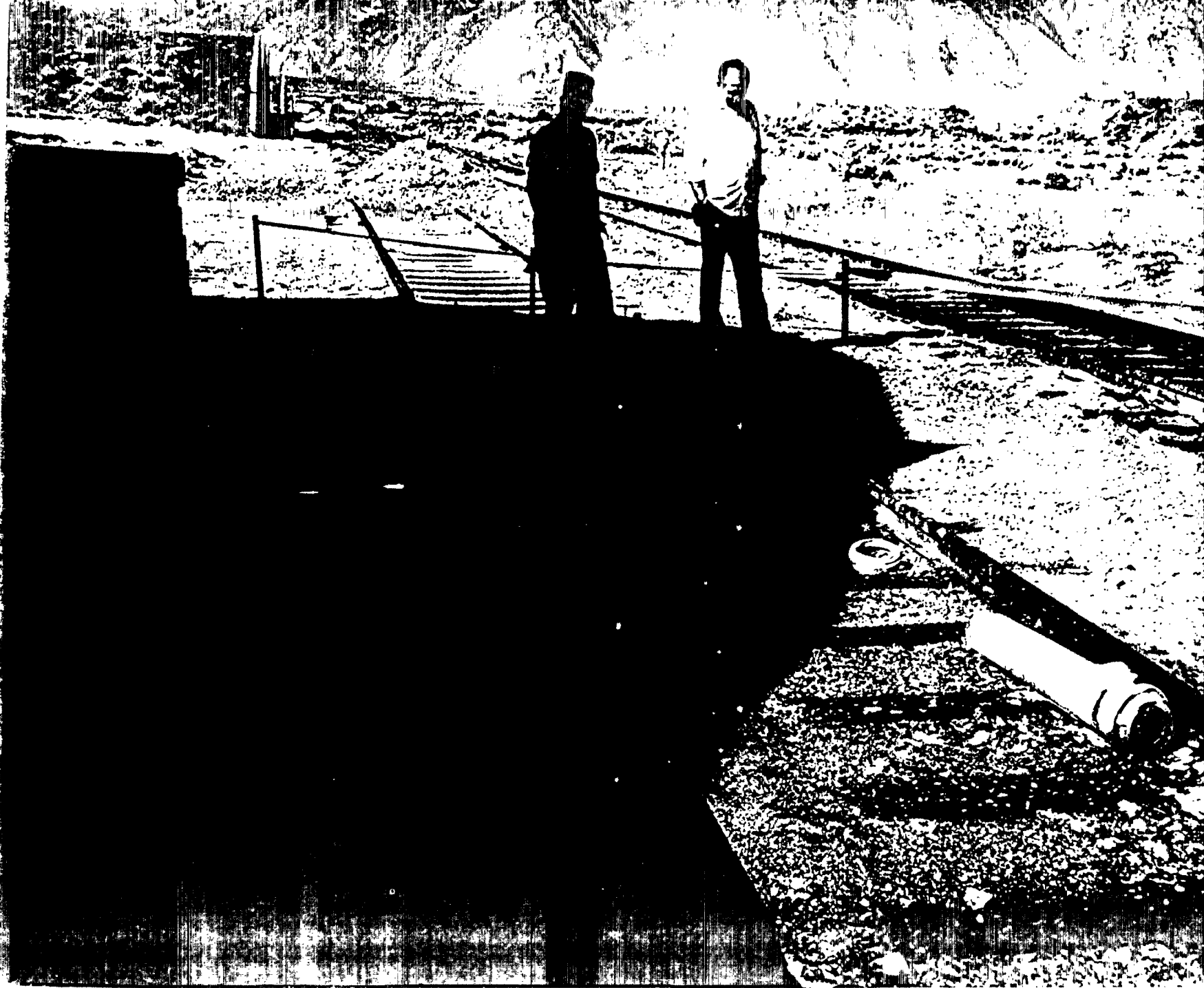
1801





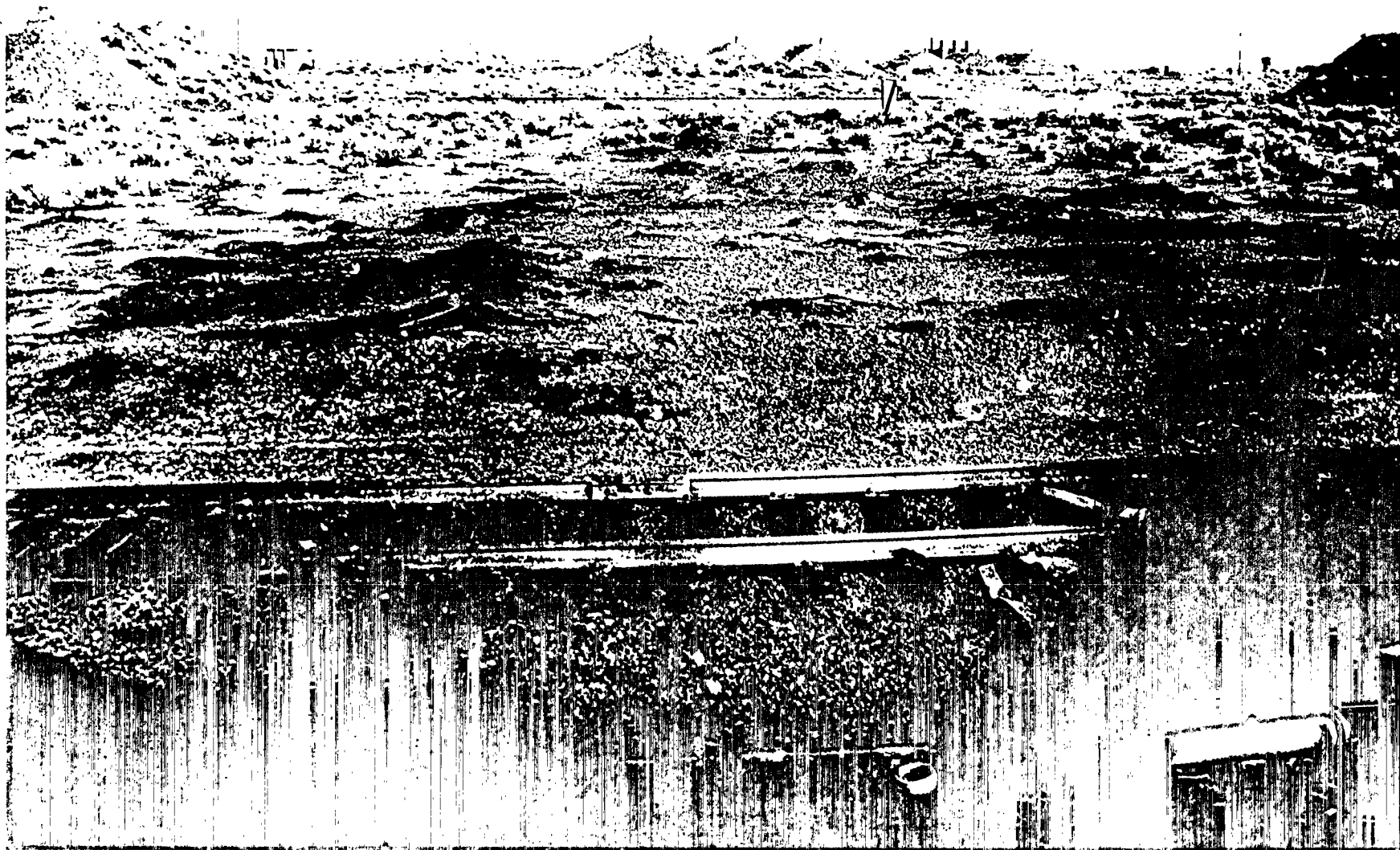


1801



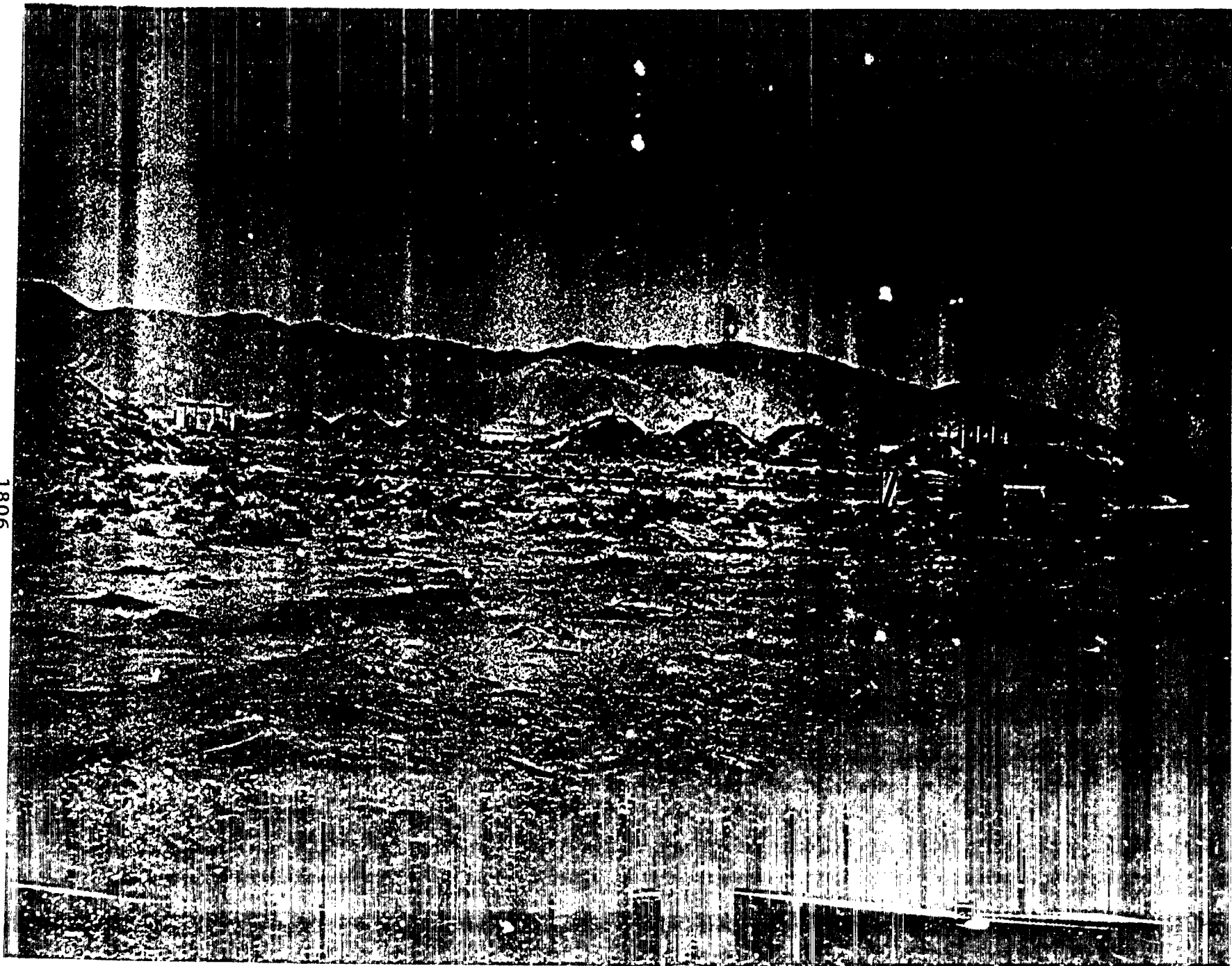
00
40

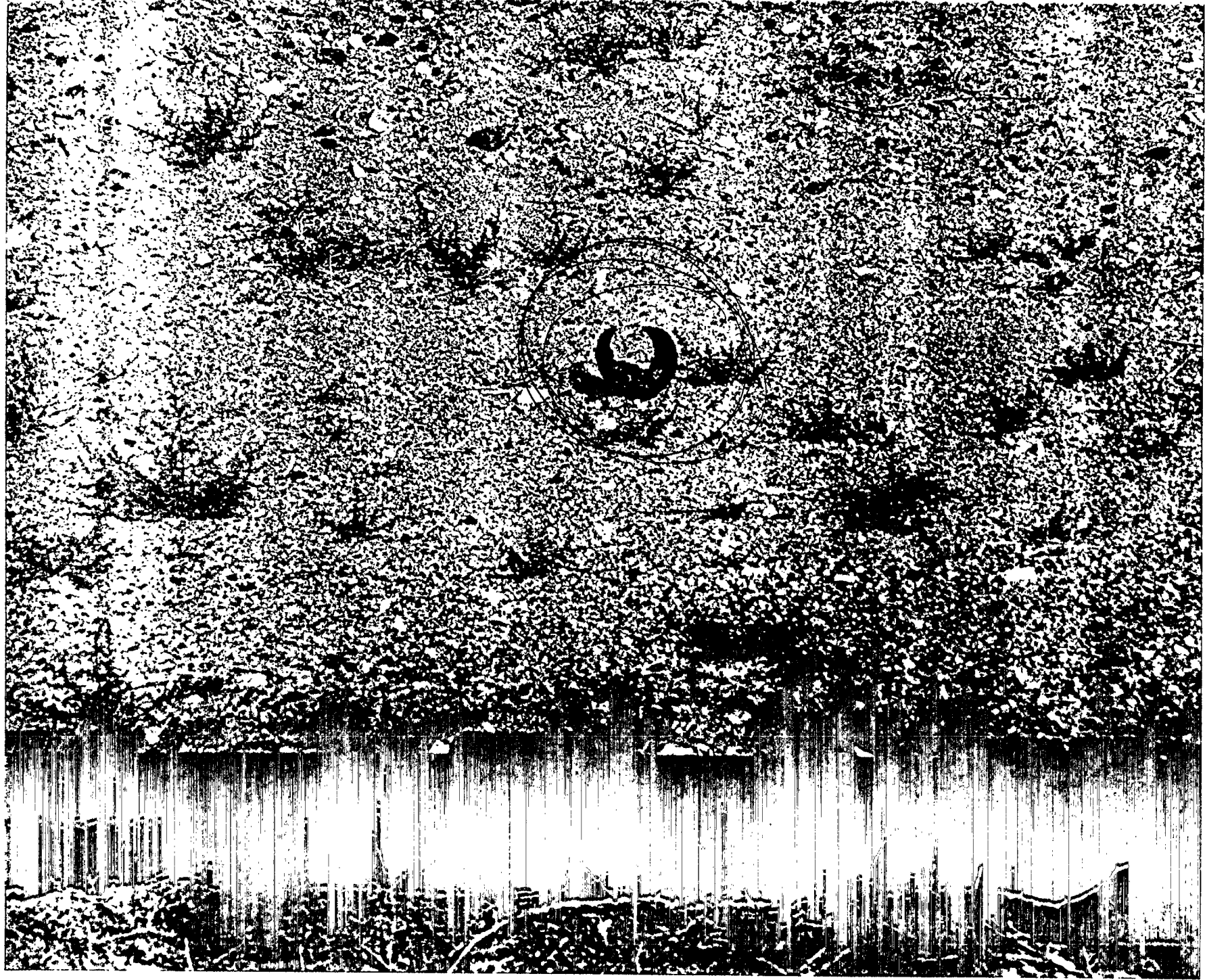
1805



33

1806



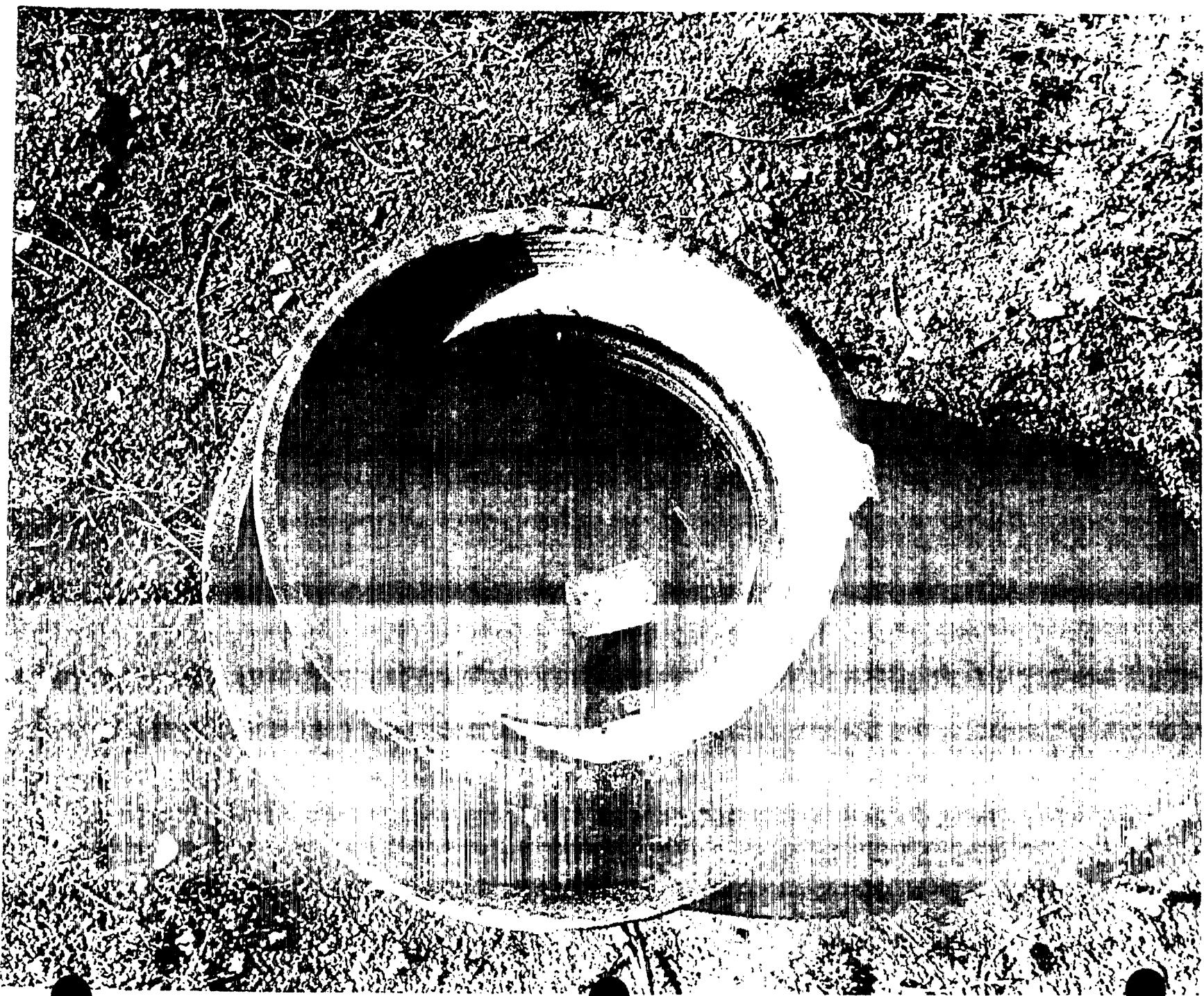


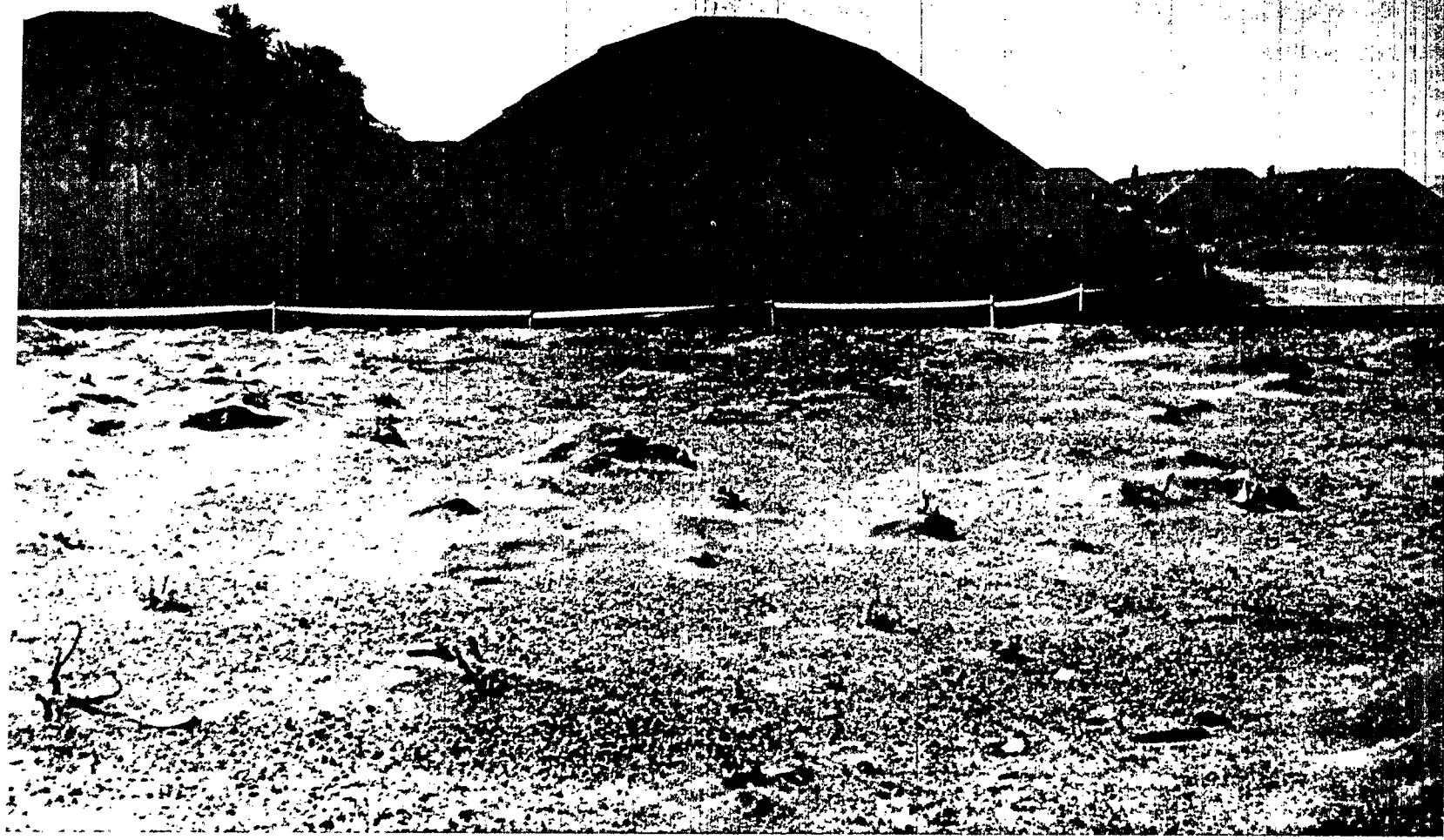
REFERENCES

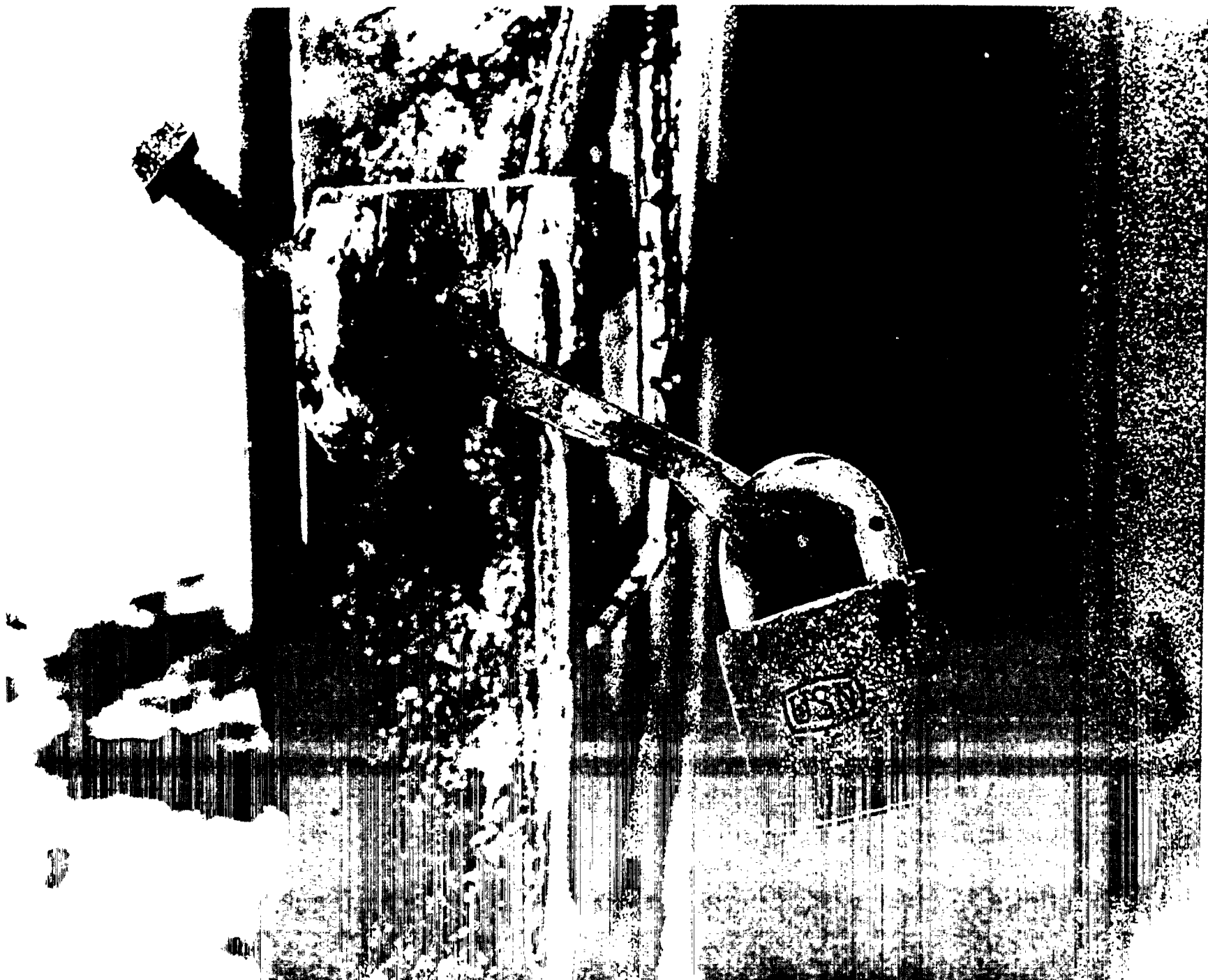
1. Joint Australian/UK Stack Fragmentation Trials Phase 1 Report
- F Bowman, J Henderson et al - D/Safety/11/55/22 undated
2. Joint Australian/UK Stack Fragmentation Trials Phase 1B Preliminary Report
- J Henderson - ESTC/162/EE/7, WP7
3. Joint Australian/UK Stack Fragmentation Trials Phase 2 Report
- J Henderson et al - D/Safety/11/55/22 dated August 1985
4. Joint Australian/UK Stack Fragmentation Trials Phase 3 Report
- J Henderson - D/ESTC/14/1/8/2 dated May 1990
5. Joint Australian/UK Stack Fragmentation Trials Phase 4 Proposal
- D/Safety/11/55/22 dated 14 Feb 1989
6. OSD Instrumentation Plan dated 5 January 1990.
7. Range Measurements Branch Trial Instrumentation Plan RMB-IPLAN-OI-029 Issue 1 dated 15 Feb 1990.
8. Defence Trial Directive for Coalesced Defence Trials 6/445 and 6/447
- DST 88/4398/6 dated 23 Mar 90.
9. D Trials Technical Instruction DST 88/4398/7 dated 6 Apr 90.
10. Letter Jenssen/Rees dated 28 Mar 90.
11. ACS Construction Report.
12. ESH Design Trial Report.
13. WES INstrumentation Report.
14. OSD Instrumentation Report.

1809









1812

41